

Issue # *	Title	Description
<b>4</b>	Battery SoC determination	The 11 September meeting has shown consensus amongst the participants on the usage of the <i>displayed state of charge</i> for measurements and KPIs. However, to ensure that the displayed SoC sufficiently represents the actual physical state of the battery, a verification is being considered. A further decision thus needs to be made on the need for verification and the verification method.

\*corresponding with drafting team outline numbering

Options	Consequences
A. Verification required, monitor Discharged Battery Energy against SoC in WLTP charge depletion-test	<ul style="list-style-type: none"> <li>● This ensures that the displayed SoC is accurate and trustworthy. Therefore, a verification would ensure that the displayed SoC is not used to improve performance indicator without actual performance improvements for the end-users. The KPI's become more accurate and comparable.</li> <li>● The verification possibility currently under review is to monitor SoC in WLTP during the charge-depleting test. This would allow an efficient test procedure, lowering the test burden of verification.</li> <li>● GRPE would need to agree to start registering SoC during the WLTP charge-depleting test</li> <li>● Further research is needed to check to what extent SoC hysteresis between charging and depleting occurs and how that would impact the accuracy of the verification.</li> <li>● <b>Testing takes more effort.</b></li> <li>● However, there is no need to determine the Recharged Energy which would give additional test burden.</li> </ul>
B. Verification required, other verification method	<ul style="list-style-type: none"> <li>● Selecting one of the other options for verification can also improve the relevance of the KPI's.</li> <li>● <b>However, as the advantages and disadvantages have been less discussed this will probably require a new round of discussions and therefore would delay the process.</b></li> </ul>

	<ul style="list-style-type: none"><li>• Testing takes more effort. Other verification methods might also require determining the Recharged Energy, which is complex to measure and potentially adds test burden.</li></ul>
C. NO verification required	<ul style="list-style-type: none"><li>• KPI's become less reliable and comparable.</li><li>• Without verification there is an incentive to bias the SOC indicator to gain better test performance, which comes at the cost of the vehicle user (less reliable SOC)</li><li>• Testing takes less effort.</li></ul>

Issue # *	Title	Description
<b>5</b>	Key performance indicators	<p>The KPI's are the information that is presented to end users to understand how a vehicle performs with regards to fast charging. Different KPI's display different aspects of recharging and can therefore also inform different use cases.</p> <p>Selecting a limited amount of KPI's will improve simplicity and therefore accessibility to the information provided. At the same time, having more KPI's will allow end users more options to compare vehicles according to the performance indicator they deem most important. Selecting KPI's will also impact test requirements and test burden.</p> <p>As some KPIs represent similar performance a selection criterium could be to prevent overlap in KPI's.</p>

\*corresponding with drafting team outline numbering

Options	Pro's and con's
A. Maximum charge power in kW during SoC window x – y %	<ul style="list-style-type: none"> <li>● Easy to compare</li> <li>● Kilowatts/power might not be a well understood concept for many end-users and could require some explanation</li> <li>● Displays high performance during the most relevant SoC range, but is often not representative of real life recharging performance as the power output tends to variate during charging. End users might become frustrated if they experience the maximum power only being delivered for short durations.</li> <li>● Creates potentially an incentive to show a short peak in the battery charging performance, which disconnects this KPI further from real life recharging performance</li> </ul>
B. Average charge power in kW during SoC window x – y %	<ul style="list-style-type: none"> <li>● Easy to compare</li> <li>● Kilowatts/power might not be a well understood concept for end-users and requires some explanation or grouping/labelling such as has been done in AFIR (annex B).</li> <li>● An average power output summarises the power curve in a single KPI and therefore represents overall charging performance</li> </ul>
C. Charging time in minutes	<ul style="list-style-type: none"> <li>● Easy to understand. Replacing kilowatts/power with minutes/time units will allow end users to better understand the KPI as this a commonly used concept.</li> </ul>

<p>from x – y % SoC window</p>	<ul style="list-style-type: none"> <li>● Comparison between vehicles are less relevant since the time that it takes to be charged within the SoC window is as much dependent on charging power as on battery capacity. A vehicle with large battery, high range and high recharging power might take longer to charge than a vehicle with small battery, low range and low charging power.</li> </ul>
<p>D. Average charging speed in recharged distance in kilometre per minute from x – y % SoC window</p>	<ul style="list-style-type: none"> <li>● Easy to compare</li> <li>● Easy to understand: recharged distance per minute combines range in kilometre with a time unit. Both are commonly used units.</li> <li>● The energy recharged (kWh) is now combined with in the energy consumption as determined by the WLTP to create a new KPI. This KPI represents overall performance within the SoC window, but it is a further derivative of the average charging power. The KPI now incorporates efficiency as determined in the WLTP. It is a less pure indicator of fast charging performance.</li> <li>● Link needs to be made with the WLTP energy consumption test. A choice would need to be made on the appropriate WLTP driving phase (urban, suburban, main roads, highways or combined)</li> </ul>
<p>E. Charging efficiency in % during SoC window x – y %</p>	<ul style="list-style-type: none"> <li>● This KPI would inform the end-user on any energy loss and would allow end users to choose a vehicle based on recharging economy/efficiency.</li> <li>● Participants in the cluster have not presented data that suggests significant energy losses occurs during DC fast charging on the vehicle side. Also the bandwidth in efficiency is unknown.</li> <li>● This would require additional measurements in the test procedure and possibly also additional equipment.</li> </ul>
<p>F. Recharged <u>range</u> (km/miles) during the first ten minutes of charging from SoC start x%</p>	<ul style="list-style-type: none"> <li>● Easy to compare</li> <li>● Easy to understand</li> <li>● This KPI represent a typical stop during long distance driving. It can thus prove the comfort of fast charging since a significant amount range can often be acquired in such a period.</li> <li>● It allows for a comparison with refuelling events of ICE vehicles.</li> <li>● A ten minutes KPI would not be representative of fast charging at higher SoC rates and might be misinterpreted, especially if no other KPI's are selected.</li> <li>● The recharged energy during the first ten minutes of recharging needs to be determined and it is now combined with the energy consumption as determined by the WLTP to create a new KPI. It is a further derivative of the power curve. It is a less pure indicator of fast charging performance.</li> <li>● Link needs to be made with the WLTP energy consumption test. . A choice would need to be made on the appropriate WLTP driving phase (urban, suburban, main roads, highways or combined)</li> </ul>

<p>G. Recharged <u>energy</u> (kWh) during the first ten minutes of charging from SoC start x%</p>	<ul style="list-style-type: none"><li>• Easy to compare</li><li>• Kilowatt hours/energy recharged might not be a well understood concept for end-users and requires some explanation</li><li>• This KPI represent a typical stop during long distance driving. It can thus prove the comfort of fast charging since a significant amount range can often be acquired in such a period.</li><li>• A ten minutes KPI would not be representative of fast charging at higher SoC rates and might be misinterpreted, especially if no other KPI's are selected.</li><li>• It does not allow for comparison with refuelling events of ICE vehicles.</li></ul>

Issue # *	Title	Description
<b>7</b>	Method for preconditioning: soak of the vehicle, mandatory drive and battery preconditioning	<p>A typical use case for a vehicle on its way to the fast-charging facility looks as follows: driving on the highway at high speed, with battery preconditioning on. At the same time, the test procedure for the FRPC could also cover more types of user behaviour.</p> <p>Testing should also be reproducible and repeatable, meaning that the condition for the vehicle at the start of the test should always be identical. The objective is therefore to develop a preconditioning procedure which stays close to the most common use cases, while ensuring the reproducibility and repeatability of the test.</p> <p>The discussion focusses on two elements of the pre-conditioning:</p> <ol style="list-style-type: none"> <li>I. Is battery pre-conditioning allowed? (A or B)</li> <li>II. At what speeds should the conditioning drive take place and what testing equipment is required? (C, D or E)</li> </ol>

\*corresponding with drafting team outline numbering

Options	Consequences
A. Battery pre-conditioning is not allowed	<ul style="list-style-type: none"> <li>● The manufacturers <u>cannot</u> achieve the fastest recharge speeds in the test.</li> <li>● End-users that do not (know how to) use the pre-conditioning option or want to prevent energy loss due to pre-conditioning will find the KPI's to be <u>close</u> to the performance perceived.</li> <li>● End-users that use the pre-conditioning (either aware or unaware of that) will find that actual performance is better than indicated by the KPI's</li> <li>● Manufacturers have less incentive to offer battery pre-conditioning as this does not improve KPI performance.</li> </ul>
B. Battery pre-conditioning is allowed	<ul style="list-style-type: none"> <li>● Manufacturers <u>can</u> achieve the fastest recharge speeds in the test.</li> <li>● End-users that do not (know how to) use the pre-conditioning option or want to prevent energy loss due to pre-conditioning will find that actual performance is worse than the indicated by the KPI's.</li> <li>● End-users that use the pre-conditioning (either aware or unaware of that) will find the KPI's to be <u>close</u> to the performance perceived.</li> </ul>

	<ul style="list-style-type: none"> <li>● This option is closer to the objective of establishing the <i>fastest</i> recharge curve.</li> </ul>
<p>C. Driving at a fixed high speed in a limited range such as 100-105 km/h, on a chassis dynamometer.</p>	<ul style="list-style-type: none"> <li>● This represents the well-known fast charging use case along the highway,</li> <li>● <b>But is less representative of other fast charging uses cases.</b></li> <li>● Using a dynamometer is needed.             <ul style="list-style-type: none"> <li>○ This improves reproducibility and repeatability of the procedure,</li> <li>○ <b>But requires expensive equipment to be available at the testing lab. It also rules out making use of public recharging facilities for the test.</b></li> </ul> </li> </ul>
<p>D. Driving at a fixed and mixed speed profile, on a chassis dynamometer.</p>	<ul style="list-style-type: none"> <li>● A fixed and mixed profile could represent multiple uses cases for fast charging.</li> <li>● <b>However, as it is a mix of different uses cases, it would less often represent a specific driving and recharging event.</b></li> <li>● Using a dynamometer is needed.             <ul style="list-style-type: none"> <li>○ This improves reproducibility and repeatability of the procedure,</li> <li>○ <b>But requires expensive equipment to be available at the testing lab. It also rules out making use of public recharging facilities for the test.</b></li> </ul> </li> </ul>
<p>E. Driving at a low speed of 25-30 km/h, the chassis dynamometer is optional. Public recharging facilities may be used.</p>	<ul style="list-style-type: none"> <li>● <b>Driving at low speeds is less representative of common driving and recharging behaviour.</b></li> <li>● The low speeds do make it possible to use public fast charger for testing. Thereby reducing the need for both a dynamometer and allowing public fast recharging station for the test. Test can thus be done by more (types of) organisations.</li> <li>● <b>Allowing for public recharging stations to be used will create less reliable and comparable test results as the power output of the recharging station might not be controllable or might not be optimal.</b> (The recharging station's available power output could be limited by its own hardware, the grid connection or others users simultaneously recharging at the facility.)</li> </ul>

Issue #	Title	Description
<b>11</b> <i>(not marked as an issue in the outline)</i>	SoC measurement and KPI range	<p>For some of the KPIs a State of Charge measurement range is to be determined. Choosing the measurement range impacts representativeness of the KPI and the test procedure (burden).</p> <p>In the cluster meeting of 11 September 2025 it was already agreed that to prevent difficulties in the testing procedure a close to zero SoC would not be chosen.</p> <p>Annex A displays the current common start and stop SoCs behaviour for fast charging along European highways.</p>

Options	Consequences
A. 10% - 80%	<ul style="list-style-type: none"> <li>● This range results in the highest performance displayed as with current battery chemistry the highest recharging speeds are typically achieved within this range. As such, the KPI promotes electromobility when compared to ICE refuelling.</li> <li>● Measuring up to the 80% end SoC represents a majority of the sessions: 65%</li> <li>● Performance between models will differ below 10% or beyond the 80% SoC. Competing and innovating beyond the 10% or 80% interval is not rewarded by better performance statistics.</li> </ul>
B. 10% - 90%	<ul style="list-style-type: none"> <li>● The KPI's will display lower performance than option A. Making charging stand out less when compared to ICE refuelling.</li> <li>● A broader range of fast charging behaviour is displayed, when compared to option A. Measuring up to the 90% SoC represents a larger amount of the sessions: 84%.</li> <li>● Performance and innovation up to 90% SoC is rewarded.</li> <li>● Broader measurement and KPI ranges increase testing time and therefore test burden.</li> </ul>
C. 10% - 100%	<ul style="list-style-type: none"> <li>● An even broader range of fast charging behaviour is displayed.</li> <li>● Performance beyond 90% SoC is now also rewarded. All end SoCs are included.</li> <li>● This range will further lower the performance displayed in the KPI's. KPI may be dominated by the charging performance from 90-100% since that takes the most time.</li> </ul>

	<p style="text-align: center;">Broader measurement and KPI ranges increases testing time and therefore test burden.</p>
<p>D. 5% - 90%</p>	<ul style="list-style-type: none"> <li>● A broader range of fast charging behaviour is displayed, about 7% of sessions start between 5-10% SoC.</li> <li>● This range will lower the performance displayed in the KPIs when compared to option A. as it also includes the 5%-10% start SoC and 80%-90% stop Soc range.</li> <li>● Broader measurement and KPI ranges increase testing time and therefore test burden. The test procedure might also become more complicated since a vehicle would need to arrive almost depleted at the test lab. If other decisions (issue 7) require a dynamometer to be used than the impact on the test burden will accumulate less if option D or E are chosen here.</li> </ul>
<p>E. 5% - 100%</p>	<ul style="list-style-type: none"> <li>● The broadest range of fast charging behaviour is displayed.</li> <li>● This range will further lower the performance displayed in the KPIs.</li> <li>● Broader measurement and KPI ranges increases testing time and therefore test burden. The test procedure might also become more complicated since a vehicle would need to arrive almost depleted at the test lab. If other decisions (issue 7) require a dynamometer to be used than the impact on the test burden will accumulate less if option D or E are chosen here.</li> <li>● KPI may be dominated by the charging performance from 90-100% since that takes the most time.</li> </ul>

## Other decisions for 14 October

The drafting team has also requested the contracting parties to decide on several minor issues. As these decisions have not raised an controversy and/or had already been decided on in the ToR the following decisions are proposed:

### 1. and 2. - Scope

- The test procedure and KPIs concern vehicles that at any point during the selected State of Charge measurement and KPI range (issue 11) reach at least 50 kW charging power. Wireless charging is excluded.

### 3. Family criteria

- The test vehicle with the expected worst-case performance is chosen to represent the family. The family itself is restricted by certain family criteria (yet to be determined, but including e.g. battery chemistry, capacity and pre-heating system). At the option of the manufacturer the family may be split into smaller subgroups.

### 9. Test vehicle criteria

- F&SC supports adding an eligibility requirement for the test vehicle, for example a State of Certified Energy (SOCE) indication which shows that at least 98% of the original capacity is available.

## Decisions for later meetings

### 8. Applicability

- Does the F&SC see the need for allowing public chargers for testing? This may jeopardize the reproducibility and repeatability of the test results on a number of issues (temperature of the EVSE and the battery, driving during preconditioning, unexpected power surge due to grid overload etc)  
> Has not sufficiently been discussed, but might have major consequences. Some decisions will implicitly be made by choices made within issues 4, 5 7 and 11.

### 10. Measurement tolerances and accuracies

- This is best decided on after deciding on the KPIs (Issue 5).

**Annex A**

**Fast charging at Fastned recharging stations in Europe**

Based on >3.1 million sessions from January 2025 - June 2025

Displayed START SoC	Share	Displayed STOP SoC	Share
0-5%	2,95%	0-5%	0,03%
6-10%	7,27%	6-10%	0,17%
11-15%	10,61%	11-15%	0,48%
16-20%	11,61%	16-20%	0,96%
21-25%	10,70%	21-25%	1,67%
26-30%	9,76%	26-30%	2,41%
31-35%	8,75%	31-35%	3,24%
36-40%	7,57%	36-40%	3,82%
41-45%	6,48%	41-45%	4,72 %
46-50%	5,57 %	46-50%	5,12%
51-55%	4,80%	51-55%	6,34%
56-60%	3,99 %	56-60%	6,10%
61-65%	3,27%	61-65%	6,97 %
66-70%	2,54%	66-70%	6,75%
71-75%	1,77%	71-75%	7,59%
76-80%	1,17%	76-80%	8,51%
81-85%	0,70%	81-85%	11,49%
86-90%	0,34%	86-90%	7,66%
91-95%	0,13%	91-95%	6,79%
96-100%	0,04%	96-100%	9,2 %

**Annex B****Charger Speed categorization in AFIR**

REGULATION (EU) 2023/1804, Annex III

2. Member States must categorise their reporting on the deployment of publicly accessible recharging points as follows:

Category	Sub-category	Maximum power output	Definition pursuant to Article 2 of this Regulation
Category 1 (AC)	Slow AC recharging point, single-phase	$P < 7,4 \text{ kW}$	Normal-power recharging point
	Medium-speed AC recharging point, triple-phase	$7,4 \text{ kW} \leq P \leq 22 \text{ kW}$	
	Fast AC recharging point, triple-phase	$P > 22 \text{ kW}$	High-power recharging point
Category 2 (DC)	Slow DC recharging point	$P < 50 \text{ kW}$	
	Fast DC recharging point	$50 \text{ kW} \leq P < 150 \text{ kW}$	
	Level 1 - Ultra-fast DC recharging point	$150 \text{ kW} \leq P < 350 \text{ kW}$	
	Level 2 - Ultra-fast DC recharging point	$P \geq 350 \text{ kW}$	